REMARKS

Applicant has reviewed and considered the Office Action dated December 27, 2007 and the references cited therein. Claims 19, 24-42, 45, and 46 were rejected under 35 U.S.C. § 102(e) and Claim 20 was rejected under 35 U.S.C. § 103(a). In view of the following remarks, Applicant respectfully requests reconsideration and allowance of the pending claims.

Claim Rejections under 35 U.S.C. § 102(e)

Claims 19, 24-42, 45, and 46 were rejected under 35 U.S.C. § 102(e) as being anticipated by Branton et al. (U.S. Patent 6,627,067). Applicant respectfully traverses the rejection for at least the following reasons.

Claim 19 is directed to a method of forming a membrane structure for use in a device to characterize polymer molecules. The method comprises, in part, "electron beam milling a nano-scale channel entirely through a self supporting portion of the thin film; and measuring the channel in-situ, wherein the milling and measuring are performed during a single presentation to an instrument."

As stated in previous responses, Applicant strongly asserts that Branton does not disclose, teach, nor suggest electron beam milling. Particularly, Branton does not disclose, teach, nor suggest "<u>electron beam milling</u> a nano-scale channel entirely through a self supporting portion of the thin film." Rather, Branton discloses microfabrication of an aperture in a solid-state membrane that requires two steps, neither of which comprises "<u>electron beam milling</u>."

To create the aperture using the Branton method, <u>each</u> of the following steps is required. First, a cavity is <u>etched</u> in the membrane 134 as shown in Branton Fig. 4G. *See* Branton, Col. 13, ll. 3-5. This cavity is a "blind hole." That is, the cavity does <u>not</u> breach both sides of the membrane 134. In fact, the cavity terminates "at an <u>interior</u> point in the membrane." Branton, Col. 13, ll. 45-46 (emphasis added); Fig. 4G. Furthermore, the dimensions of the cavity created can be, and are designed to be, <u>much larger</u> than the final diameter of the aperture. Branton, Col. 13, ll. 42-45. This cavity-forming step is performed with a <u>lithographic</u> instrument. Branton, Col. 13, ll. 5-18.

After the cavity has been lithographically etched partially through the membrane 134, the membrane is "thinned" until the thinning intersects the narrow bottom portion of the pre-etched cavity, thereby creating an aperture, or thru-hole. Branton, Col. 13, li. 56 - Col. 14, li. 13. In fact, "the aperture formation process of the invention relies on structural thinning, rather than lithography, to define the final aperture geometry." Branton, Col. 13, ll. 38-40. The step of structural thinning is required in the Branton method because the cavity created in the first step has too large a diameter, for the stated purpose of molecular and atomic scale evaluation of biopolymers, to be formed entirely through the membrane and used as the final aperture. Thus, both steps of blind cavity creation and thinning to intersect the cavity are required to create a "nano-scale channel entirely through a self-supporting portion of the thin film."

The Examiner first points to Branton Column 13, lines 3-17 and Column 13, line 55-Column 14, line 34 and asserts that electron beam lithography is equivalent to electron beam milling "because each is employed to remove the thin film in order to create a hole therethrough." Applicant respectfully, though strongly, traverses the Examiner's assertion for at least the following reasons.

Branton does not disclose electron beam milling of the cavity. Rather, Branton discloses electron beam lithography or photolithography of the cavity. Branton, Col. 13, ll. 3-17. As is well known in the art, during electron beam lithography, the electron beam is used only to expose the electron beam resist layer, such as PMMA for example, which is then developed leaving a void in the resist layer, where the resist layer was exposed by the electron beam. The cavity in the resist layer is subsequently exposed to an etchant, typically a reactive ion plasma gas of CF4, CHF3, or SF6. *See* Branton, Col. 13, ll. 25-27 ("a relatively isotropic etch process, e.g., a reactive ion etch process, is carried out to form a bowl-shaped cavity . . .)." Such relatively isotropic etch processes result in a cavity that does not have vertical side walls. In any event, electron beam lithography and electron beam milling are not equivalent. Thus, Branton does not disclose electron beam milling of the cavity.

Branton, however, discloses electron beam etching or assisted etching as an additional thinning process for enabling "controlled thinning of a structure to intersect a cavity on a surface opposite that being thinned." Branton, Col. 14, ll. 13-19. That is, Branton discloses electron

beam etching or assisted etching for purposes of carrying out the second step of the two-step process, i.e., the thinning step. As is typically understood in the art, electron beam etching means electron assisted chemical etching. Branton discloses that electron beam etching comprises structural thinning in order to create a completed aperture through the membrane 134. The invention, in fact, "relies" on structural thinning otherwise the aperture created would be too large for the stated purpose. As such, Applicant respectfully asserts that Branton does not disclose electron beam milling, which is the entirely different and novel technique disclosed by Applicant.

The Examiner further points out that, in Paragraph [0042], Applicant states "a channel 75 is cut through thin film 60 with a focused ion beam 70 or other suitable precision milling device such as electron beam lithography" and incorrectly, improperly, and without valid support asserts that Applicant therefore states that electron beam lithography is an equivalent precision milling technique to electron beam milling. Office Action dated December 27, 2007, p. 3. Applicant respectfully points out to the Examiner that Paragraph [0043], which immediately follows the quote that the Examiner points to, when read in context, discusses electron beam milling as an alternative to milling with a focused ion beam or electron beam lithography wherein apertures of appropriate scale can be fabricated through relatively deep or thick substrates. Applicant nowhere equates electron beam lithography to electron beam milling. In fact, the referenced sentence of Paragraph [0042] recites:

> [A] channel 75 (as illustrated in FIG. 2E) is cut through the thin film 60 with a focused ion beam (FIB) 70 or other suitable precision milling device such as electron beam lithography, neutral particle beam, charged particle beam, x-ray, or other suitable mechanism.

While the referenced sentence refers to suitable precision milling devices, contrary to the Examiner's assertion, nowhere in the referenced sentence does Applicant equate any two milling devices or techniques. Rather, Applicant lists different suitable devices for cutting through the thin film 60. In fact, as stated above, Applicant goes on to differentiate electron beam milling in Paragraph [0043], which specifically address electron beam milling:

> [C]hannel diameters of 1-5 nm and preferably 2-5 nm would be appropriate. One way to achieve apertures of this scale through a

> material is with a Transmission Electron Microscope ("TEM"). TEM drilling involves the bombardment of the material by a stream of high energy electrons on the order of 100 KeV.

Applicant, thus, clearly distinguishes electron beam milling from the process described in Branton, which requires both the steps of blind cavity creation and thinning to intersect the cavity to create a "nano-scale channel entirely through a self-supporting portion of the thin film," neither step of which is required by Applicant's Claim 19.

As a practical matter and as established by Dr. Gregory T. Cibuzar in the attached Affidavit under 37 C.F.R. § 1.132, one skilled in the art would understand that electron beam lithography is different than electron beam milling. As established by Dr. Cibuzar, to one skilled in the art, electron beam lithography specifically refers to lithographic patterning using a beam of electrons to expose the photoresist. Electron beam lithography systems create beams of electrons with accelerating voltages in the range of 10 to 100 kilovolts (KV). These accelerating voltages are sufficient to chemically modify the photoresist, but not high enough to cause changes to the surface of the substrate. Electron beam lithography systems are generally based on scanning electron microscope (SEM) technology, a well-known materials and surface characterization method. In electron beam lithography, the beam of electrons takes on the role that light plays in traditional lithography.

Conversely, as established by Dr. Cibuzar, "milling" refers to processes specifically designed to remove material from the surface of a substrate using a physical mechanism (as opposed to a chemical mechanism). High energy particles, such as argon or gallium atoms, or electrons can be used to perform milling. Milling effectiveness is directly related to the momentum of the particles. Momentum is defined as mass times velocity; using electrons for milling requires very high energy electron accelerating voltages – over 100KV. Creation of a beam of electrons with this high accelerating voltage can be accomplished with a transmission electron microscope (TEM). An electron beam lithography system does not have sufficient accelerating voltage to cause milling of the surface.

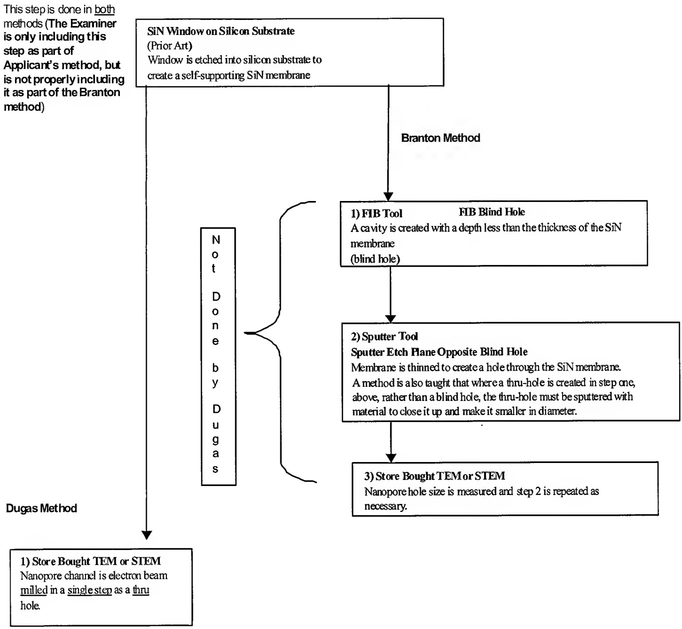
Thus, Branton does not disclose electron beam milling during either the cavity creation step or the thinning step. As such, nowhere does Branton disclose, teach, or suggest "electron beam milling a nano-scale channel entirely through a self supporting portion of the thin film."

Branton merely discloses a required thinning step subsequent a cavity creation step. Additionally, contrary to the Examiner's assertion, nowhere in Applicant's specification does Applicant equate electron beam milling and electron beam lithography.

Applicant further maintains that Branton teaches away from electron beam milling since neither step of cavity creation (required by Branton) nor thinning (required by Branton) is necessary with electron beam milling, as claimed by Applicant. Electron beam milling creates an aperture of appropriate size without the requirement of first etching a cavity nor the need to thin back the membrane. It is respectfully asserted that Applicant has clearly disclosed a novel technique of using direct electron beam milling to define a nano-scale channel. No intermediate cavity, such as disclosed and required by Branton, is necessary.

As stated in previous responses, Applicant also strongly asserts that Branton comprises more steps than Applicant's method. The Examiner asserts that Applicant's method is a two-step process including "a) a hole or window is etched in the silicon substrate and the lower layer of the thin film using standard lithography techniques, b) creating a channel (aperture) 75 by cutting through thin film 60 with electron beam milling (lithography)." Office Action dated May 9, 2007, p. 8. First, as noted above, Applicant does not equate electron beam lithography with electron beam milling, and the Examiner is incorrect in concluding that such are equivalent. Second, as Applicant has previously stated, the step of etching a window in the silicon substrate is prior art and is done by both methods of Applicant and Branton, and the Examiner cannot add the step to Applicant's method while removing the step from the Branton method in order to make both have an equivalent number of steps. Such assertions are improper and further inherently illustrate that Applicant's method as claimed is novel over the prior art.

As previously presented to the Examiner, and now presented in a simpler form for the Examiner's convenience, the diagram below compares the processes disclosed in Branton and in Applicant's application.

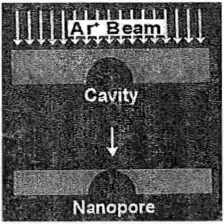


Applicant has never counted the additional window etching step as part of the two subsequent steps required by Branton. <u>Even without including the window etching step as part of the Branton method</u>, as stated above, subsequent to etching a window in the silicon, Branton still requires <u>1)</u> the step of cavity creation and <u>2)</u> the step of thinning. Etching a window in the

silicon substrate is not the same step as cavity creation disclosed in Branton. The step of cavity creation disclosed in Branton, as stated above and in prior responses, requires a cavity to be etched in the membrane 134 as shown in Fig. 4G after the window has already been etched in the silicon. *See* Branton, Col. 13, ll. 3-5. Typically, the cavity is created on the opposite side of the membrane as the silicon window. *See* Brangon, Col. 13, ll. 11-17. The cavity terminates "at an interior point in the membrane." Branton, Col. 13, ll. 45-46 (emphasis added); Fig. 4G. As Applicant has requested before, if the Examiner intends to continue including the step of etching a window in the silicon substrate as an additional step in Applicant's method (bringing Applicant's method to two steps), then Applicant respectfully asserts that the Examiner is required to also include the step of etching a window in the silicon substrate as a step in the Branton method, making the Branton method a three-step method.

Additionally, as stated in previous responses, Applicant also strongly asserts that Branton does not measure in-situ nor mill and measure during a single presentation to an instrument. Particularly, Applicant continues to maintain that Branton does not disclose, teach, nor suggest "measuring the channel in-situ, wherein the milling and measuring are performed during a single presentation to an instrument." Branton merely discloses a feedback mechanism used during only the thinning step, i.e., the second step of a two-step process, in which both steps are required to form the resulting aperture. The aperture creation and the measuring are, thus, not "performed during a single presentation to an instrument."

Furthermore, the feedback mechanism of Branton is merely a mechanism used for obtaining an inferred, or indirect, estimation of the size of the aperture. "The feedback mechanism is based on detection of a physical species [such as Argon] provided during the thinning etch in a manner that is indicative of the physical dimensions of . . . an aperture." Branton, Col. 14, ll. 25-28. The following diagram illustrates the feedback mechanism.



Using the feedback mechanism disclosed in Branton, the amount of a physical species, e.g., Argon, pouring through the aperture, as it is widened by the thinning process, is detected. Once a certain amount of Argon is detected, the thinning process is caused to be halted. This is, in fact, not a measurement of the aperture, but merely an estimate of the size of the aperture. This method is not as accurate as measuring the channel in-situ. Furthermore, the feedback mechanism disclosed in Branton must be calibrated using direct measurements of the diameter of an aperture. Thus, Branton does not disclose "measuring the channel in-situ, wherein the milling and measuring are performed during a single presentation to an instrument."

In conclusion, Branton does not disclose, teach, nor suggest, electron beam milling, in-situ measuring, nor milling and measuring during a single presentation to an instrument. Particularly, Branton does not disclose, teach, nor suggest "electron beam milling a nano-scale channel entirely through a self supporting portion of the thin film; and measuring the channel in-situ, wherein the milling and measuring are performed during a single presentation to an instrument," as recited in Applicant's Claim 19, and the above remarks obviate the basis for this ground of rejection.

Therefore, Claim 19 is not anticipated by Branton. Claims 24-42, 45, and 46 depend from Claim 19, and are patentable for the same reasons as Claim 19 and for the additional limitations recited therein. For example, Branton does not disclose a method, "wherein the nano-scale channel has substantially vertical side walls," as recited in Applicant's Claim 46. As stated above, Branton requires 1) the step of cavity creation and 2) the step of thinning. Branton specifically discloses "[t]he cavity thins inward from the membrane surface to terminate at an

interior point in the membrane." Branton, Col. 13, ll. 45-46. This is because "the aperture formation process of the [Branton] invention relies on structural thinning . . . to define the final aperture geometry." Branton, Col. 13, ll. 38-40. Thus, Branton does not disclose a channel having "substantially vertical side walls." The Examiner has not provided any support for the conclusory rejection of at least Claim 46. As such, it is not clear to Applicant how at least Claim 46 is not allowable over the cited art. Reconsideration and withdrawal of the rejections under 35 U.S.C. §102 are respectfully requested.

Claim Rejections under 35 U.S.C. § 103(a)

Claim 20 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Branton et al. (U.S. Patent No. 6,627,067) in view of Nisch et al. (U.S. Patent No. 6,218,663). Applicant respectfully traverses the rejection for at least the following reasons.

Claim 19, from which Claim 20 depends, is directed to a method that comprises, in part, "electron beam milling a nano-scale channel entirely through a self supporting portion of the thin film; and measuring the channel in-situ, wherein the milling and measuring are performed during a single presentation to an instrument."

For the reasons stated above, Branton fails to disclose, teach, or suggest the invention of Claim 19. Instead, Branton discloses an aperture-forming process that requires two steps. The first step in the Branton process is a cavity-forming step that is performed with a lithographic instrument. *See* Branton, Col. 13, ll. 5-18. The second step is a thinning step that is performed by any of several processes except lithography. Branton, Col. 13, ll. 38-40. Furthermore, Branton discloses a feedback mechanism that is used only during one step of the aperture formation process resulting in more than one presentation to an instrument and merely provides an estimate of the aperture diameter, not a measurement of the aperture itself. Thus, Branton fails to teach or suggest "electron beam milling a nano-scale channel entirely through a self supporting portion of the thin film; and measuring the channel in-situ, wherein the milling and measuring are performed during a single presentation to an instrument."

Nisch fails to remedy the fundamental disclosure deficiencies of Branton. As noted in the Office Action, Nisch teaches ion etching for local thinning of a sample. *See* Nisch, Abstract.

The purpose of Nisch is to "carry out target preparations under high-resolution observing conditions and to eliminate contaminant or reactive layers," such as an oxide layer. Nisch, Abstract. Thus, Nisch, at most, discloses one method of performing the second step – the thinning step – of the Branton method. In fact, Branton teaches that the thinning step can be performed by various ion beam methods. *See* Branton, Col. 14, ll. 14-16. Such a combination of Branton and Nisch thus results in an aperture-forming method that still requires more than a "single presentation to an instrument." Additionally, nothing in Branton or Nisch teaches or suggests modifying Branton's process such that it is performed during a single presentation to an instrument.

In fact, Branton teaches away from a single-step process of aperture formation. In Branton, the benefits of the first step - the cavity forming step – are discussed at length. That is, Branton teaches that the cavity forming step can be used to achieve "a desired cavity geometry." *See* Branton, Col. 13, l. 32. Further, Branton states that "[p]referably, given the characteristics of a selected cavity etch process, the cavity pattern extent is correspondingly selected to produce a desired extent at the cavity bottom, and to produce a range of cavity expanses between the cavity bottom and the membrane surface." Branton, Col. 13, ll. 48-52. Thus, the cavity forming step is a vital part of the Branton invention. As such, Branton teaches away from milling a nano-scale channel through a self supporting portion of the thin film and measuring the channel, wherein the milling and measuring are performed during a single presentation to an instrument.

Thus, neither Branton nor Nisch, alone or in combination, teach or suggest "electron beam milling a nano-scale channel entirely through a self supporting portion of the thin film; and measuring the channel in-situ, wherein the milling and measuring are performed during a single presentation to an instrument" as recited in Applicant's Claim 19. Because claim 20 depends directly from claim 19 and incorporates all the limitations of Claim 19, the above remarks obviate the basis for this ground of rejection. Thus, Claim 20 is not made obvious by Branton in view of Nisch. Reconsideration and withdrawal of the rejection are respectfully requested.

Conclusion

This response is being submitted on or before October 27, 2008, with a Request for Continued Examination along with the fee of $405.00 and the required fee of $245.00 for a two-month extension of time, making this a timely response. It is believe that no additional fees are due in connection with this filing. However, the Commissioner is authorized to charge any additional fees, including extension fees or other relief which may be required, or credit any overpayment and notify us of same, to Deposit Account No. 04-1420.

This application now stands in allowable form and reconsideration and allowance is respectfully requested.

Respectfully submitted,

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